National Aeronautics and
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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Flight Software Branch

Software Process Improvement Plan

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Baseline		12/12/01	Baseline Release
Revision	A	7/22/02	Block Update of SPI Plan
Revision	B	5/9/03	Changes to correspond to OWI Rev L
Revision	C	11/9/04	Editorial update to clarify requirements language in response to Headquarters Rules Review Action. Update to QD org code. Update of headers, footers, export control language, and History Log (SPI SCR 21). Editorial update due to 10/04 center re-organization (SPI SCR 88). Document number change to adhere to SRB document numbering procedure (SPI SCR 88).
Revision	D	10/12/05	Deleted all flow diagrams in section 8, Add revised flow diagram to section 1.2, deleted Appendix A "SW-CMM Discussion & Levels 2 & 3 KPA", replaced "EI32" with "FSB", replaced "OWI" with "SDPDD", changed the title of section 6.0 from "Assumptions and Risks" to "Assumptions", updated the "Software Process Improvement Infrastructure" and the "FSB Process Improvement Cycle", updated "NASA Reference Documents", added CMMI to history, added symbol key to appendix. Implementation of SCR 99 (update the SPIP for CMMI modifications), 108 (Peer Review findings) and 113 (Baseline SPIP).
Revision	E	2/27/07	Updates associated with annual review. Update Figure 6-1 (FSB SPI Infrastructure). Modified the footer reference to the MIDL and the document number to reference FSB. Added MSG reference. Added the Organizational SPI Goals to the plan. Modified to expand the scope of this plan. Implementation of SCR 158 (Baseline SPIP).

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1.0 INTRODUCTION

This Software Process Improvement Plan (SPIP) describes the software process improvement strategy for the National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) Engineering Directorate (ED), Space Systems Department and Spacecraft & Vehicle Systems Department, Flight Software Branches (FSB), EI32 and EV22 and is the "roadmap" for the process improvement effort.

This plan describes the structure necessary to identify, implement, track, and control software engineering improvement. Led by the Management Steering Group (MSG), process improvement is a continuous activity implemented by selected project individuals and/or teams to evaluate and proactively plan, address, and implements all process improvements. This document is maintained to reflect changes and improvements. This plan will be reviewed and/or updated at least once a year.

In early 2001, the FSB Senior Management chartered the FSB Software Engineering Process Group (SEPG) to serve as the facilitator of the FSB Software Process Improvement (SPI) effort.

1.1 Scope

The scope of this document applies to software developed by the FSB.

1.2 Purpose

In according with NPR 7150.2 NASA Engineering Requirements, SWE-003, this document provides overall guidance on SPI for the FSB. The strategy uses the FSB Software Policies, the Software Development Process Description Document (SDPDD), the FSB Training Plan, the FSB Software Organizational Metrics Plan (OMP), the SEPG Charter and Membership, Software Review Board (SRB) Charter and Membership, SPI Initiative MSG Terms of Reference and the Final Reports from the Software Capability Evaluations as guides. This SPI Plan uses the Software Engineering Institute's (SEI's) Capability Maturity Model Integration (CMMI) for Software (Version 1.1) to determine the activities necessary to continue maturing the organization's software process.

Figure 1 shows the process improvement planning flow. See Appendix B for the symbol key.

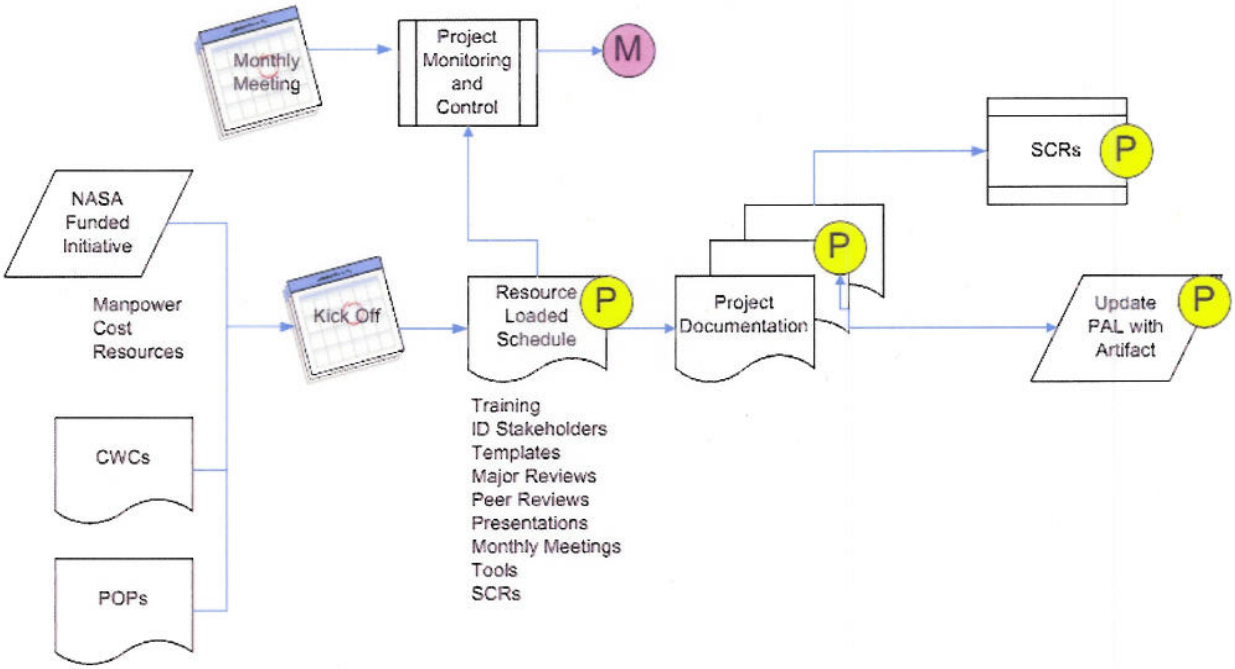

Figure 1 Process Improvement Planning Flow

1.3 Background

The Flight Software Group (FSG), which is now known as the Flight Software Branch, EI32, SPI effort began in 1999 after receiving our ISO 9000 compliance. A defined strategy for process improvement was initiated. The group was using SEI's CMM as the framework for developing and maturing the FSG software process. FSG contracted for a formal SEI-sanctioned Software Capability Evaluation (SCE) in December 2000. The purpose of the evaluation was to identify areas for improving the FSG software process. The SCE concluded that FSG was performing as a Level 2 organization based on the SEI CMM Version 1.1 criteria.

The results of the SCE assessment are documented in Appraisal Final Report, SCE, dated December 2000. FSG contracted for a formal SEI-sanctioned SCE in August 2002. The purpose of the evaluation was to identify areas for improving the FSG software process and to benchmark FSG software development against CMM Level 3 activities. The SCE concluded that FSG was performing as a Level 2 organization based on the SEI CMM Version 1.1 criteria and met nine of 12 Key Process Areas of a Level 3 organization. The results of the SCE assessment are documented in Appraisal Final Report SCE, dated August 2002.

In May 2003, an SCE was performed on the FSG. The SCE concluded that the FSG was performing as a CMM Level 3 organization. The results of the SCE are documented in

Appraisal Final Report SCE, dated May 23, 2003. In October 2005, a Standard Capability Maturity Model Integration (CMMI) Appraisal Method for process Improvement (SCAMPI) A was performed on the EI32, Flight Software Branch. The SCAMPI A concluded that the branch was performing as a CMMI Level 2 organization. The results of the SCAMPI A assessment are documented in MSFC FSB Final Findings.ppt, dated October 21, 2005.
The FSBs EI32 and EV22 are currently working toward a Software CMMI Capability Level 3.

1.4 Organizational SPI Goals

In support of FSB Policies FSB-EI32-MEMO-003 and FSB-EV22-MEMO-001, the following goals were identified and established for the FSB Software Process Improvement Program. These goals are based on the high level information needs and improvement objectives of the organization.

1. Track project and product development progress
2. Improve software quality
3. Establish productivity trends over time
4. Improve the estimation process for future projects
5. Continuously improve processes across the organization

2.0 REFERENCE DOCUMENTS

2.1 NASA Documents

Table I addresses all of the NASA documents that were used as reference material in creating this document.

Table I NASA Reference Documents

Document Number/ Revision/Date	Document Title
EI32-OI-001 Current Issue	FSB Software Development Process Description Document
MWI 7120.4 Revision D July 25, 2005	Documentation Preparation, Programs/Projects
NPR 7150.2 September 27, 2004	NASA Software Engineering Requirements
MSFC-PLAN-3204 Revision B October 28, 2004	MSFC Software Engineering Improvement Plan
FSB-EI32-MEMO-003 Current Issue	Memo for Record – FSB Policy
FSB-EV22-MEMO-001 Current Issue	Memo for Record – FSB Policy
Terms of Reference October 2006	SPI Initiative Management Steering Group
FSB-SEPG-CH Current Issue	SEPG Charter
FSB-SEPG-MEMO-001 Current Issue	SEPG Membership
EI32-TrP Current Issue	FSB Training Plan
FSB-SRB-CH Current Issue	Engineering Directorate, Data Systems and Software Division and Avionics Systems SRB Charter
FSB-SRB-MEMO-001 Current Issue	SRB Membership
EI32-OMP Current Issue	FSB Software OMP

2.2 Non-NASA Documents

Table II addresses all of the Non-NASA documents that were used as reference material in creating this document.

Table II Non-NASA Reference Documents

Document Number/ Revision/Date	Document Title
IEEE/EIA 12207.1-1997 April 1998	Industry Implementation of International Standard ISO/IEC 12207:1995, Software life cycle processes – Life cycle data
IEEE/EIA 12207.0-1995 March 1998	Industry Implementation of International Standard ISO/IEC 12207:1995, Software life cycle processes
Center for Systems Management, Inc. Document, December 2000, August 2002, May 2003, and October 2005	Appraisal Final Report, SCE
SW-CMMI 1.1	CMMI, version 1.1

3.0 DEFINITIONS

Acronyms are located in Appendix A.

4.0 OVERVIEW

This Plan is a guide for the FSB software process improvement. This plan provides historical information on the FSB process development activities and establishes the approach for continued process maturity and growth.

Section 5 defines critical assumptions.

Section 6 describes the organizational entities established to implement the process improvement effort of the FSB. Roles, responsibilities and interfaces for these groups are also defined.

Section 7 provides the implementation methodology to move the FSB from the current software maturity level to higher levels. An evolutionary process for SPI is presented with associated roles, tasks and responsibilities.

Section 8 provides a mapping to the current milestone schedule. The schedule highlights tasks to be accomplished for the FSB to improve its software process capability.

In summary, this SPI Plan provides the plan and framework for the process improvement efforts of the FSB.

5.0 ASSUMPTIONS

It is assumed that the MSG continually provides strong support and commitment to the SPI effort. The Branch Chiefs and all other members of the SRB are actively involved in the supervision of the process improvement agenda. Additionally, all other FSB personnel continue to support the SPI activity. Support involves active participation in working groups such as the SEPG and Technical Working Groups (TWGs). Software Assurance (SA) support continues. Software process audits are conducted to ensure that the organization is following its defined standard software process.

6.0 ORGANIZATION FOR PROCESS IMPROVEMENT

Process improvement oversight within the FSB is the responsibility of the SRB. In order to obtain further details about the responsibilities and composition of the SRB, refer to the SRB Charter and the SRB Membership Memo. The SRB is responsible for approving the SPI Plan and approving process improvement recommendations.

The SEPG is tasked with performing the following activities:

- Define and recommend the FSB processes relating to software development/maintenance.
- Serve as point of contact for software engineering information
- Establish and maintain a repository of project information; hereafter referred to as the Organization Standard Process Database (OSPD)
- Develop/maintain standards, plans and procedures (including the FSB SPI Plan)
- Establish a mechanism to collect and disseminate software process information to all the FSB personnel; hereafter referred to as the Process Asset Library (PAL)
- Provide assistance in implementing policies, processes and procedures
- Define tailoring guidelines
- Mentor
- Prepare and teach courses
- Present briefings
- Assist customers and other organizations on issues related to organizational software process improvement
- Present the FSB's achievements and lessons learned in the area of software process improvement
- Serve as the focal point for appraisals.

The MSG members meet with the SEPG on a monthly basis to address process improvement issues; hereafter referred to as the MSG Meeting. Agendas are developed and minutes/action items are documented. The SEPG is responsible for briefing the MSG members on software process improvement activities.

The SEPG, in coordination with the NASA MSFC Training Office, has the responsibility of coordinating, developing, and maintaining the FSB SPI-specific training program. The FSB Organizational Training Plan and training records stored in the FSB training database are to be monitored by the SEPG to assist in the overall skill development of the FSB personnel. The SEPG provides regular status reports to the MSG members.

The FSB's SA support is responsible for performing audits to ensure the organization is following their defined software process. These audits are important in maintaining the current

maturity level and ensuring that process and product deficiencies are corrected in a timely manner. SA reports the results of process audits to the FSB Senior Management.

The infrastructure and interfaces of the FSB SPI Organization is depicted in Figure 2 the FSB Software Process Improvement Infrastructure.

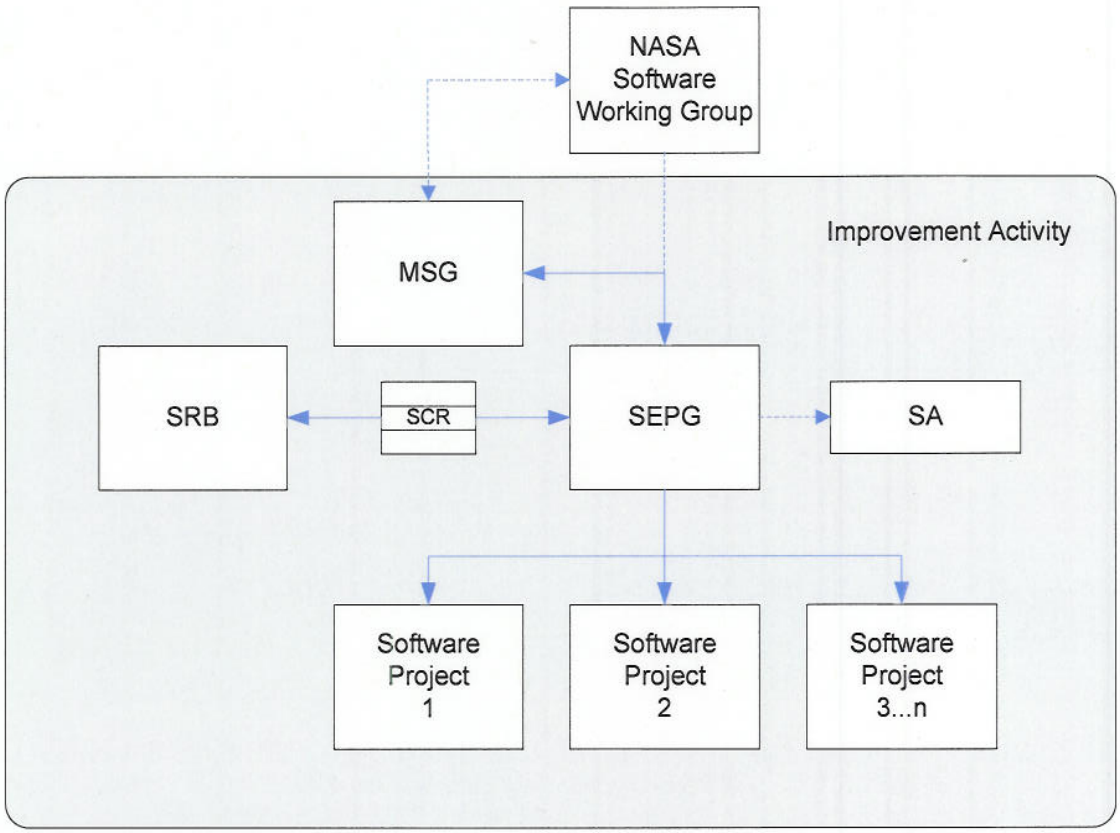

Figure 2 FSB Software Process Improvement Infrastructure

7.0 IMPLEMENTATION METHOD

This document implements an evolutionary strategy to address development and incorporation of improved processes into the FSB organization. This section identifies tasks, roles and responsibilities and describes the evolutionary SPI process. The application of this eight step process is dependent on the scope of the improvement activity.

7.1 Key Process Roles

Key process improvement roles referenced in the following process description are listed below:

Table III Role and Responsibilities

Relevant Stakeholders	Responsibilities
Internal	
Management Steering Group	Responsible for providing organizational commitment, policy, specific goals, resources, and the infrastructure to achieve SPI.
Software Project Lead	Responsible for developing plans and software engineering processes for their project tailored from the FSB process assets, and staff training, compliance to the FSB Software Policy, and the monitoring of project progress and overall management of their project.
TWG Personnel (Requirement Engineer, Design Engineer, and Test Engineer)	Subject matter experts from within the FSB brought together to address a particular functional area of process improvement. Work closely with SEPG. The TWGs roles, responsibilities, scope, and objectives are explained via informal meetings, emails, or Software Change Requests (SCRs), which are developed for each improvement activity on a case-by-case basis.
SEPG	Acts as the FSB software engineering focal point with responsibility for the development, management, and maintenance of Software Development Process assets
Software Review Board	Approves process improvement recommendations
External	
Software Assurance	Objectively evaluates organizational process improvement effort and reports non-conformances

7.2 Process Steps

The cycle of steps shown in Figure 3 is implemented to migrate the FSB to CMMI and then through repeated application to higher levels of maturity. The details of each Step are explained in Sections 7.2.1 through 7.2.8. A mapping to the detailed SPI schedule developed to implement the SPI plan is located in Section 8.0. The SPI schedule is maintained by the SEPG in Microsoft Project.

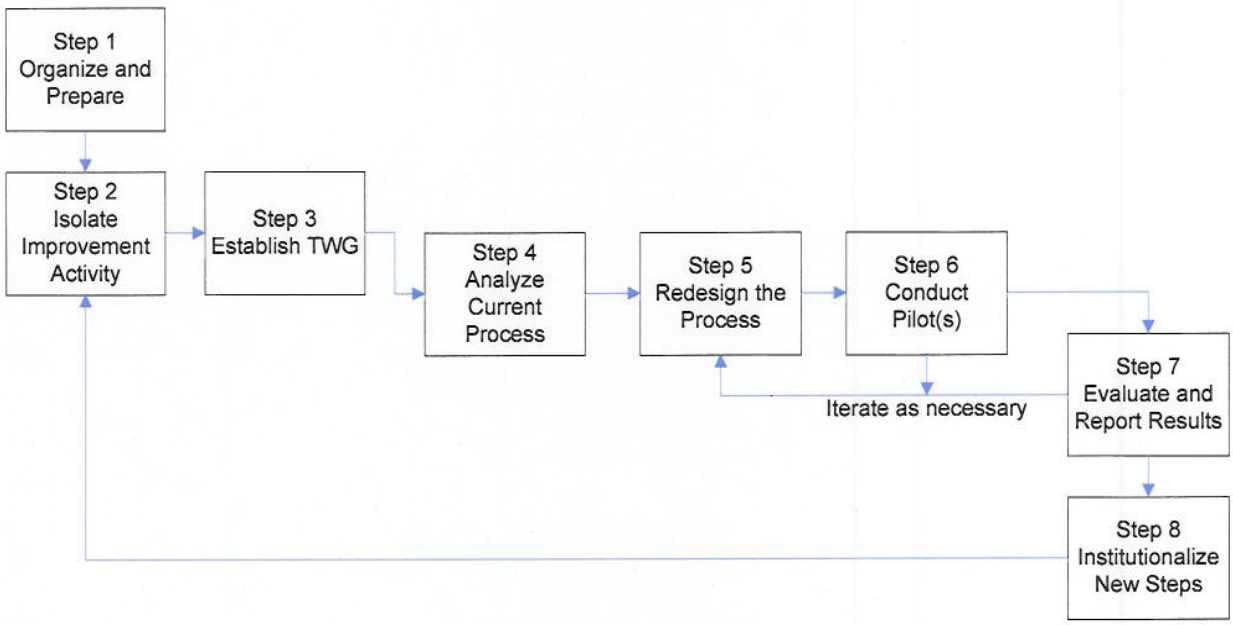

Figure 3 FSB Process Improvement Cycle

7.2.1 Step 1 - Organize and Prepare

Objective	
The objectives of Step 1 (Organize and Prepare) are to: Establish Goals of the FSB. Formulate SPI Approach. Initiate the FSB Process Improvement Activity.	
Entrance Criteria	
FSB Software Policy	
Tasks, Roles, Responsibilities	
MSG	Define Goals and Objectives of the FSB SPI Initiate the FSB Process Improvement Activity via SEPG Charter

	Select SEPG Chairperson Solicit and approve SEPG members via SEPG Memo Authorize SEPG training Review the FSB SPI Plan and provide comments Communicate the plan to the FSB Personnel
SRB	Approve the FSB SPI Plan
SEPG	Identify training needs Obtain training Formulate the FSB SPI Approach Draft the FSB SPI Plan Present the FSB SPI Plan to MSG Revise SPI Plan based upon MSG's comments (if necessary) Initiate and establish the FSB PAL resources
TWG	None
Project Lead	None
SA	Review the FSB SPI Plan
Exit Criteria	
SEPG Charter SEPG Memo Staffed and trained SEPG Approved the FSB SPI Plan Initial the FSB PAL is established	

7.2.2 Step 2 – Isolate an Improvement Activity

Objective
The objective of Step 2 (Isolate an Improvement Activity) is to: Identify and isolate a single (initial or next) Functional Area for process improvement activity.
Entrance Criteria
SEPG Charter SEPG Memo The SEPG has been staffed and trained. An approved the FSB SPI Plan. An Established PAL Current definition of the Standard Organizational Process (SDPDD) exists.

Tasks, Roles, Responsibilities	
MSG	None
SRB	Review and prioritize SPI SCR for candidate Improvement Activities. Authorize the Improvement Activity
SEPG	Review the Standard Organizational Process (SDPDD). Select Functional Area for Analysis. Identify goals and objectives within Functional Area. Identify data needed to measure current process within Functional Area to accomplish goals. Identify candidate Improvement Activities objectively. Submit candidate Improvement Activities via SPI SCR(s). (Any FSB member or SA has the ability to submit a SPI SCR.) Present candidate SPI SCR(s) to SRB
TWG	None
Project Lead	None
SA	None
Exit Criteria	
A Functional Area for an Improvement Activity has been identified and isolated and then submitted and approved by the SRB. Approved SPI SCR	

7.2.3 Step 3 - Establish TWG

Objective
The objective of Step 3 (Establish TWG) is to: Establish a TWG to develop an approach to implement the Improvement Activity.
Entrance Criteria
An Improvement Activity has been selected and approved via an SPI SCR.

Tasks, Roles, Responsibilities	
MSG	None
SRB	Review and provide comments for TWG membership criteria

	Approve TWG members Authorize TWG Training needs
SEPG	Define and document scope, objectives, and roles of the TWG. Establish criteria for TWG membership. Select candidate TWG members based upon knowledge & skills criteria. Identify TWG training needs. Train the TWG.
TWG	None
Project Lead	None
SA	None
Exit Criteria	
A TWG has been tasked for the Improvement Activity. The TWG is staffed and trained	

7.2.4 Step 4 - Analyze Current State of Process

Objective	
The objectives of Step 4 (Analyze Current State of Process) are to: Assess and document the strengths and weaknesses of the existing process for the Functional Area as defined in the Organizational Work Product. Define a quantitative approach for measuring the defined process, as it relates to the Improvement Activity.	
Entrance Criteria	
TWG's objectives and roles are established Staffed and trained TWG Established PAL	
Tasks, Roles, Responsibilities	
MSG	None
SRB	Review and provide comments on TWG Approach to implement Improvement Activity Approve TWG Approach for implementation
SEPG	Review and comment on TWG detailed process description (with TWG); thus verifying the TWG understands the existing process. Communicate the TWG Improvement Activity Approach to Senior Management

	via the MSG Meeting (with assistance from TWG members, as necessary)
TWG	Conduct process data gathering. Develop a detailed existing process description Develop detailed description of the FSB Best Practices in the Functional Area (from PAL) Develop quantitative approach for measuring existing process, as it relates to Improvement Activity (if necessary) Review detailed process description (with SEPG) Refine the process description (if necessary). Develop approach to implement Improvement Activity Assist SEPG with communication of this approach to Senior Management
Project Lead	None
SA	None
Exit Criteria	
Approved approach to implement Improvement Activity Approved approach to measure existing process, as it relates to Improvement Activity	

7.2.5 Step 5 – Redesign the Process

Objective	
The objective of Step 5 (Redesign the Process) is to: Develop the technical design of the new process.	
Entrance Criteria	
Approved approach to implement Improvement Activity Approved approach for measuring existing process against Improvement Activity (if necessary)	
Tasks, Roles, Responsibilities	
MSG	None
SRB	Review and comment on redesigned process Approve redesigned process
SEPG	Review TWG redesigned process Communicate the plan to Senior Management (with assistance from TWG as necessary) Perform impact and risk analysis Develop initial deployment actions for redesigned process

	Develop initial process training materials
TWG	Conduct research Identify components of the solution Redesign components of the solution Develop description of redesigned process Develop measurements to compare against existing process (if necessary) Communicate redesigned process to SEPG Document the redesigned process, including analysis criteria for Improvement Activity success
Project Lead	None
SA	None
Exit Criteria	
Initial written description of redesigned process for the Improvement Activity in the Functional Area Impact and risk analysis of redesigned process performed Initial Deployment actions for implementing redesigned process Initial training materials for redesigned process.	

7.2.6 Step 6 – Conduct Pilot (if necessary)

Objective	
The objectives of Step 6 (Conduct Pilot) are to: Identify and select candidate Pilot Project(s) able to implement the redesigned process. Inject the redesigned process into the chosen Pilot Project(s).	
Entrance Criteria	
Initial written description of redesigned process in the Functional Area and necessary metrics Initial Deployment actions for redesigned process Initial Training Materials for redesigned process	
Tasks, Roles, Responsibilities	
MSG	None
SRB	Approve selection of Pilot Project to test the Improvement Activity.
SEPG	Identify candidate Pilot Project(s) able to implement the redesigned process Solicit Senior Management approval for Pilot Project selection

	Conduct collaborative planning with Pilot Project Lead Develop Pilot Project Implementation actions (with Project Lead) Review initial project specific training materials for new process (with Project Lead) Train Project personnel in performing the new process Support and monitor the Pilot Project
TWG	Redesign the process (if necessary)
Project Lead	Conduct collaborative planning (with SEPG) Develop Pilot Project Implementation actions (with SEPG) Review initial project specific training materials for new process (with SEPG) Gather Pilot Project metrics
SA	None
Exit Criteria	
Approved Pilot Project Pilot Project Deployment actions defined Project Personnel trained in the redesigned process Revised process description (if necessary)	

7.2.7 Step 7 – Evaluate and Report Results

Objective	
The objective of Step 7 (Evaluate and Report Results) is to: Gather, evaluate, and distribute the results of piloting the redesigned process	
Entrance Criteria	
Current description of redesigned process Pilot Project implementation plan	
Tasks, Roles, Responsibilities	
MSG	Review results of Pilot Approve/Disprove adoption of new process for the FSB
SRB	None
SEPG	Gather Pilot Project results (analyze metrics) (with Project Lead)

	Document Pilot Project results (with Project Lead) Refine process description (if necessary, with TWG) Update PAL Communicate Pilot Project results to Senior Management via MSG Meeting Recommend adoption/rejection of new process to Senior Management Close SPI SCR
TWG	Redesign the process (if necessary, with SEPG)
Project Lead	Gather Pilot Project results (analyze metrics) (with SEPG) Document Pilot Project results (with SEPG)
SA	Review the process
Exit Criteria	
Documented results of Pilot Project Updated PAL Revised process description (perhaps) Approval for group-wide adoption of redesigned process Closed SPI SCR	

7.2.8 Step 8 – Institutionalize Improved Process

Objective	
The objective of Step 8 (Institutionalize the Process) is to: Institutionalize the improved process across the FSB	
Entrance Criteria	
Current description of redesigned process Closed SPI SCR	
Tasks, Roles, Responsibilities	
MSG	Communicate results of Process Improvement activity to the FSB and other stakeholders
SRB	None
SEPG	Update Organizational work products to reflect improved process Prepare final training materials Disband TWG Conduct training. Communicate results.

TWG	None
Project Lead	None
SA	None
Exit Criteria	
Updated Organizational work product Finalize process training materials Trained personnel	

8.0 MILESTONE SCHEDULE

The SPI Schedule provides the major milestones to meet for the FSB to improve its software process capability rating and to reach the FSB software process improvement goals.

Each activity listed in the schedule is considered significant and critical in the progress toward the organization's goal. Preliminary assessments are planned to serve as checkpoints for the organization. The SEPG is responsible for planning and conducting these pre-assessments, but requires the support of other FSB personnel.

The SPI Schedule is located in the PAL\OSPD\Project Schedules\SPI.

Appendix A. Acronyms

Acronym	Definition
EIA	Electronic Industries Association
CM	Configuration Management
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integrated
ED	NASA MSFC Engineering Directorate
FSB	Flight Software Branch
FSG	Flight Software Group
IEEE	Institute of Electrical and Electronics Engineers
MSFC	Marshall Space Flight Center
MSG	Management Steering Group
MWI	Marshall Work Instruction
NASA	National Aeronautics and Space Administration
OMP	Organizational Metrics Plan
OSPD	Organization Standard Process Database
PAL	Process Asset Library
SA	Software Assurance
SCAMPI	Standard Capability Maturity Model Integration (CMMI) Appraisal Method for process Improvement
SCE	Software Capability Evaluation
SCR	Software Change Request
SDPDD	Software Development Process Description Document
SEI	Software Engineering Institute
SEPG	Software Engineering Process Group
SPI	Software Process Improvement
SPIP	Software Process Improvement Plan
SRB	Software Review Board
SW	Software
TrP	Training Plan
TWG	Technical Working Group

Appendix B. Symbol Key: